

REMOVAL OF SULFUR DIOXIDE FROM FLUE GASES BY AN ELECTROCHEMICAL METHOD

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Sulfur dioxide can be considered as one of the most important air pollutants in micro and macro scale because of its effect on human and nature. Sulfur dioxide is a quite irritant, non flammable, colorless and non explosive suffocating smelling toxic gas. SO₂ is affected by other atmospheric components catalytically or photochemically to produce SO₃, H₂SO₄ mists and H₂SO₄ salts (1). These acids deposit with rain drops on plants, soil, living organisms, buildings, lakes, rivers and seas. Acid rain affects the health of humans and animals living where it falls down, directly and indirectly. At some atmospheric conditions, sulfur dioxide content emitted from emission sources becomes so excessively dense locally that may cause collective death for human and animals.

Every day, one million ton SO_x is emitted to atmosphere from anthropogenic sources. A lot of districts in the world are being exposed to high SO_x concentrations and taking urgent precautions is required to reduce these emissions.

Especially in the developed countries, precautions to protect the air quality are to be applied immediately. A lot of methods have being developed for the removal of air pollutants present at flue gases of large combustion plants.

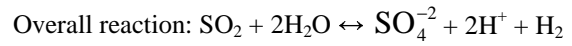
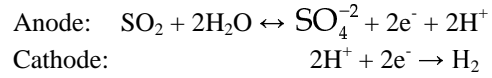
Sulfur dioxide emitted from power plants, chemical and mineral industries, is generally found at low concentrations at huge volume of gases. Methods using removal of sulfur dioxide are summarized below:

- (i) By wet gas washing method, conversion to calcium sulfate by lime and air
- (ii) By aqueous absorption and desorption (Wellman-Lord Process), concentration and then oxidation of concentrated SO₂ to sulfuric acid catalitically
- (iii) At high temperature, reduction with natural gas and production of elemental sulfur
- (iv) Oxidation of SO₂ to sulfuric acid by methods using ammonia, hydrogen peroxide or manganese as redox couples (2)

All these processes have disadvantages of requiring a lot of chemicals, regeneration of reagents or oxidants, reheating of stack gases before emitting to atmosphere. Although catalytic oxidation is attractive for SO₂ removal, it has low removal rate. Electrochemical SO₂ removal is applicable as an alternative method.

Gaseous pollutants can be converted to harmless components by electrochemical reactions. Electrochemical gas purification methods can be applied basically in two steps: At the first step, gases to be removed are absorbed in the aqueous electrolyte. Then, in the second step, they can be converted to harmless components by electrochemical oxidation or electrochemical reduction.

In the electrochemical SO₂ removal, while sulfur dioxide dissolved in acidic solution is anodically oxidized, hydrogen is produced at the cathode (3,4).



In this study, at the cylindrical electrochemical reactor with 50 cm height and 7.5 cm diameter, removal of contaminated model gas mixture consisting of SO₂ and N₂ was studied using platinum anode. From the studies, percent removal rate, current yield and energy consumption were determined at varying initial SO₂ concentration, gas flow rate and applied current value. At 5000 ppm, 98% removal was achieved at 10 Amper, and at 1Amper a removal rate of 94% was achieved with current efficiency of 94% and energy consumption of 1.76x10⁻³ kWh/g.

References

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